

REMARKS

Applicants' attorney wishes you thank the Examiner for the careful consideration given to this case. The matters raised in the action are discussed below in the same order as presented by the Examiner.

Initially, it is noted that a typographical error has been corrected at page 8 of the specification. It is clear that no issues of new matter arise.

Further, claim 1 has been amended to include limitations originally presented in claims 2 and 3. Accordingly, claims 2 and 3 have been canceled.

The rejection of claims 1 and 4 under 35 USC 103(a) as being unpatentable over Yoder (5,225,366) in view of Dreifus et al. (5,420,443) is in error and should be withdrawn. As discussed below in greater detail, the materials disclosed in the cited patents are covered with diamond, but the diamond is not in the form of a monoatomic layer.

Yoder's material is covered with a thin film of diamond having a thickness which is therefore much higher than a monoatomic layer as claimed herein. This is consistent with the Yoder invention which is generally indicated to be a method of growing films of semiconductor elements (column 4, line 22 and column 5, lines 7-10). Accordingly, the patent teaching does not contemplate a monoatomic layer, but rather, the provision of a film having a substantially greater thickness for use in a semiconductor.

Dreifus discloses a material in which diamond is in the form of one or several layers (column 5, lines 60-63) as

distinguished from the claimed monoatomic layer. In addition, the diamond layer of Dreifus becomes approximately monocrystalline only when it reaches a certain thickness, i.e., not a monoatomic layer. This is because such a layer tends to a highly oriented structure (close to, but not identical with, a monocrystalline) only after a certain thickness, due to a texture phenomenon which is associated with a selective growth of the formed crystals. Dreifus therefore contemplates a 3D germination (a Wolmer-Weber type 3D germination) on a SiC substrate, with a high crystal density which makes it possible to obtain a coalescence of the crystals together with the formation of a film at appropriate growth conditions.

It is further emphasized that claim 1 has been amended to recite that the monocrystalline substrate of SiC is either a layer in  $\beta$ SiC (100), formed on a platelet of Si or a platelet of monocrystalline SiC in hexagonal phase. As a result of such further limitation, it is clear that the present invention contemplates the use on a monocrystalline substrate having a lattice constant that is different from the lattice constant of diamond.

In Yoder and Dreifus the lattice constant of the substrate on which diamond is deposited is close to the lattice constant of diamond in order to favor growth and deposition of diamond by an epitaxy process. By definition, epitaxy is a crystal growth technique used for forming (by means of a chemical reaction on the surface of a monocrystalline substrate) thin layers of materials whose

chemical species are different from the substrate chemical species, but whose crystalline structure and therefore lattice constant, are identical with the crystalline structure and lattice constant of the substrate. Accordingly, the claimed substrates have lattice constants different from the lattice constant of diamond and thereby distinguish the present invention over the Yoder and Dreifus teachings.

In Yoder a carbon deposition is carried out by an epitaxy process, and the deposition is on a substrate having a crystalline structure that is close to the diamond crystalline structure (column 9, lines 33-35). In Dreifus a fabrication method is disclosed with reference to U.S. patent application serial number 07/937,481 (column 5, lines 16-17). In the abstract of the cited application, it is stated that "the biasing pretreating may be used to nucleate diamond heteroepitaxially on a substrate having a surface film formed on a material having a relatively close lattice match to diamond, such as beta-silicon carbide."

Contrary to the epitaxy film formation in Yoder and Dreifus, the present invention utilizes the transformation of a plane of  $sp$  type carbon into a plane of  $sp^3$  type to provide the monoatomic layer. Accordingly, the present invention contemplates transforming the hybridization of the carbon on the last atomic layer of the specifically prepared SiC substrate, and there is no question of nucleation and growth phenomena as in the cited art.

In the transformation technique of the invention, the lattice constant of the substrate is different from the diamond lattice constant. Claim 1 assures this difference in lattice constant by specifically reciting the substrate compositions as noted above and thereby distinguishes the claimed invention.

The difference in lattice constant in accordance with the invention is demonstrated by the 22% difference between the diamond lattice constant (0.3567nm) and that of the  $\beta$ SiC substrate (0.4358nm). On the other hand, Yoder and Dreifus contemplate substantially less difference between their substrate lattice constant and that of diamond in a manner consistent with epitaxy processing. For example, Yoder has a lattice constant difference of less than 1% in the copper (lattice constant 0.360nm) and boron nitride (lattice constant 0.362) embodiment.

In summary, it is submitted that one skilled in the art would not be led to the present invention by Yoder or Dreifus since the cited prior art patents contemplate the use of substrates having lattice constants close to those of the materials to be deposited.

It is requested that the Examiner reconsider and withdraw the rejection of claim 2 under 35 USC 103(a) as unpatentable over the foregoing combination of references, and further in view of Powers et al. The deficiencies of the combination of the teachings in Yoder and Dreifus to meet amended claim 1 are not remedied by Powers et al.

As indicated in the prior amendment, Powers et al. is referenced as document (12) at page 7 of the subject application. Powers et al. relates to a c(2x2) surface of cubic SiC (100) which is terminated by a plane of sp type carbon (acetylene), and not a plane of sp<sup>3</sup> type carbon (diamond) as in the subject application. The Powers et al. method consists of preparing the c(2x2) surface by either (1) eliminating the monoatomic layer of (2x1) Si which covers the first plane of carbon using a heat treatment or (2) carburizing this monoatomic Si layer of 2x1 configuration by cracking a hydrocarbon.

It is requested that the Examiner reconsider and withdraw the rejection of claim 3 under 35 USC 103(a) as unpatentable over the foregoing combination of references, and further in view of Kackell et al. The deficiencies of the combination of the teachings in Yoder and Dreifus to meet amended claim 1 are not remedied by Kackell et al.

It is requested that the Examiner reconsider and withdraw the rejection of claims 1, 2, 4-6 and 8-11 under 35 USC 103(a) as unpatentable over Powers et al in view of Liu et al. Contrary the Examiner's comments, the preparation process disclosed in Liu et al. does not make it possible to obtain a monoatomic layer of diamond on a substrate. At best, it makes it possible to obtain diamond powder or a film of diamond (column 2, lines 43-46).

Even if the process of Liu et al. was applied on the material disclosed by Powers et al. as suggested by the Examiner, a monoatomic and monocrystalline layer according

to the claimed invention would not be obtained. This is true because Liu et al. teaches a process which makes it possible to transform a material containing carbon with an undetermined hybridization degree into a material containing carbon which is partly  $sp^3$  hybridized.

The Liu et al. process consists of heating a substrate containing carbon between two electrodes through which a high-intensity current circulates in order to make a diamond type material. The thus obtained contact between the electrodes has several disadvantages or drawbacks:

- a) it modifies the electrical properties of the substrate and therefore perturbs the crystalline structure of the substrate (note that there is even a question of mechanically stressing the substrate - see column 5, lines 33-35); and
- b) it chemically pollutes the substrate with the electrode material.

Accordingly, Liu et al. does not make it possible to obtain a monocrystalline diamond layer. At best, Liu et al. makes it possible to obtain a diamond type material (a mixture of carbons having  $sp^2$  and  $sp^3$  configurations - see column 1, lines 27-30 or metastable diamond or a material whose structure is close to that of diamond and which is polluted by the electrode material - see column 1 and column 2, lines 58-60.)

It is further noted that Liu et al. teaches that it is necessary to alternate a heating phase and a fast cooling phase in order to obtain a diamond product (see - column 2,

lines 10-27). Such a fast cooling step is not used in the process of the invention.

Lastly, it is noted that the process in Liu et al. cannot take place in an ultra-vacuum and requires contact between a substrate and another material (the electrode). The process in accordance with the present convention is different because it requires a very low pressure ( $5 \times 10^{-9}$  Pa in the example at page 6, line 14) and the only material used by this process is a substrate.

For all of the foregoing reasons, claims 1 and 3-14 are in condition for final allowance and such action is requested.

If there are any further fees required by this communication, please charge the same to Deposit Account No. 16-0820, Order No. 33585.

Respectfully submitted,

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